# Ink deposition system for printed electronics


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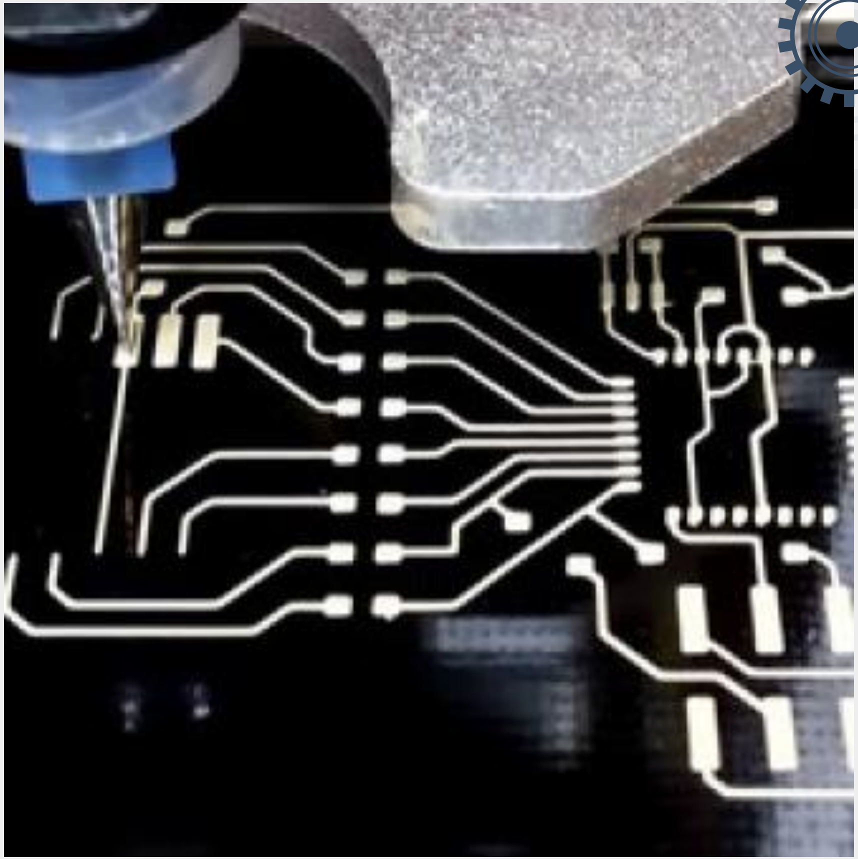
# List of contents

# Introduction

- 3D printing of electronics revolutionizes manufacturing by enabling the production of complex and customized electronic systems in a single print, offering unprecedented efficiency and flexibility.
- Ink printing for electronics using 3D printers revolutionizes electronic device manufacturing by enabling the deposition of conductive inks to create customizable and cost-effective electronic components and circuits.
- 3D printers are being researched for printing PCBs by depositing conductive ink onto a substrate, offering potential time and cost savings compared to traditional manufacturing methods.



# Literature Review

- **Espera, Alejandro H., et al.** explored recent advances in 3D printing and advanced manufacturing for electronics, covering materials, techniques, challenges, and opportunities. It discusses various materials and techniques used, along with their advantages, limitations, and potential applications. The review emphasizes the transformative potential of these technologies while highlighting the challenges that need to be addressed for widespread implementation.

- **Tan, Hong Wei, et al.** focused on metallic nanoparticle inks for 3D printing of electronics, covering their properties, production methods, and potential applications. It discusses 3D printing techniques and highlights challenges related to ink dispersion and oxidation. The review emphasizes the transformative potential of metallic nanoparticle inks in enabling complex and customized electronic device production.

- The review by **Goh, Guo Liang, et al.** focuses on recent advances and challenges in 3D printing of multilayered and multi-material electronics, covering techniques, materials, and applications. It discusses benefits such as complex geometries and rapid prototyping, along with challenges like high resolution and conductivity. The review emphasizes the potential for revolutionizing electronic device manufacturing while addressing the need for further research and development in performance and scalability.

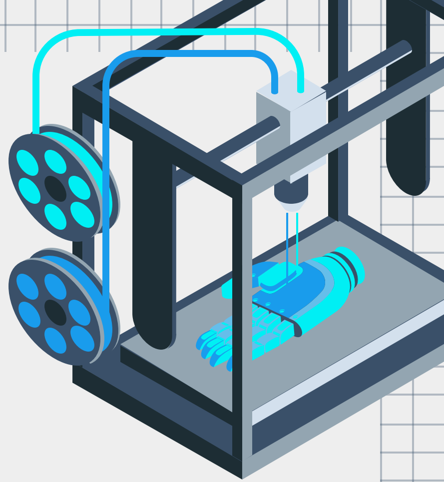
# Literature Review

- The literature review by **Park, Young-Geun, et al**. focuses on recent advancements in high-resolution 3D printing for electronics, covering techniques, materials, and applications. It discusses benefits such as complex geometries and rapid prototyping, along with challenges like precision and accuracy. The review emphasizes the potential for revolutionizing electronic device manufacturing while addressing the need for further research and development in performance and scalability.

- A review by **Leigh, Simon J., et al.** studied on the development of a low-cost conductive composite material for 3D printing of electronic sensors. It discusses the fabrication and characterization of the material, highlighting its potential applications in strain, temperature, and pressure sensors. The review emphasizes the need for further research to optimize the material's properties and scalability for mass production.

- The literature review by **Rao, C. Hanumanth, et al.** discusses the current state of printed electronics using digital 3D printing, covering fabrication techniques, materials, challenges, and future opportunities. It emphasizes the advantages of 3D printing for complex geometries and waste reduction, and explores the various digital 3D printing techniques and materials used in printed electronics. The review also highlights challenges like high-resolution printing and device integration, while discussing future prospects such as IoT integration and improved cost-effectiveness and scalability.

# Research Gap

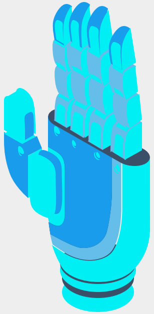


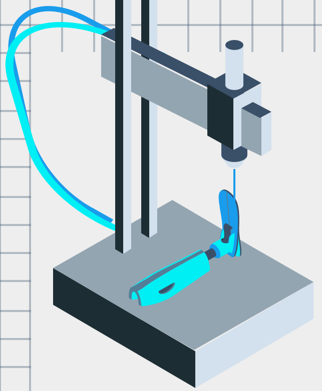
## 01

Ink printing using a 3D printer has limitations in achieving precise control over the thickness of the printed liquid ink. Regulation of ink flow through the nozzle is crucial to achieve a targeted ink thickness of 400 microns on the substrate.

## 02

The ideal printing mechanism should be cost-efficient and require less space compared to conventional printers. Additionally, the ink should be cured during the printing process to ensure proper adhesion and solidification of the printed layers.





# Objectives

## 01

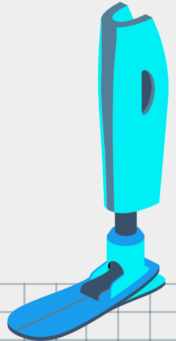
Determine ink printer flexibility within a 400-600 micron thickness range for substrate printing. Evaluate printer's ability to handle conductive materials.

## 02

Test various liquids with different viscosities using specific nozzle diameters. Assess printer's adaptability to different materials and properties

## 03

Automate ink flow from reservoir to nozzle. Verify extraction, flow rate, and control suitability for ink printer setup.



# Research Methedology

01 Defining Objective and scope of study

02 Researching the optimal system

03 Designing a System digital model using Autodesk Fusion 360

04 To manufacture an embodiment of a physical machine

05 Assembling the main frame structure with printed mount.

06 Adding the peristaltic pump and custom code motherboard( reality v4.2.2 board ) to the system

07 Testing the system's reliability and stability

08 Experimenting with the system with different ink with different viscosity

09 Comparing the assumed data and experimental data

10 Concluding the study

# Expermiental Setup

## Machine Frame

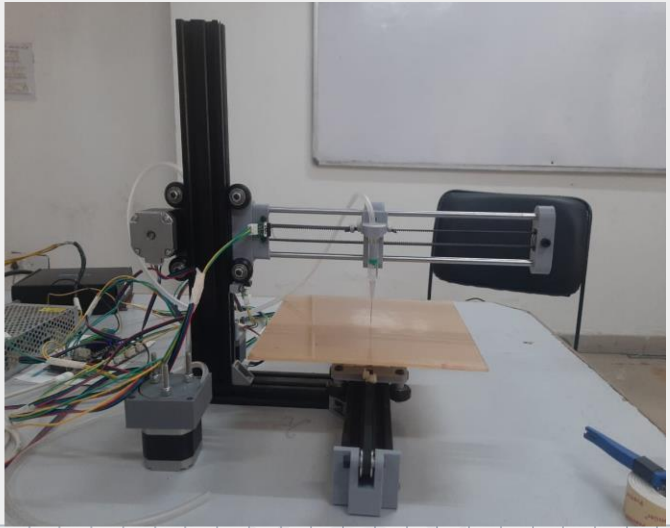
Sturdy aluminum extrusions and steel brackets provide a stable and rigid structure.

## Frame Dimensions

V-slot profile with 40x40 mm dimensions for the base and Y axis, and 20x40 mm dimensions for the Z axis.

## X-Axis Design

Features a cantilever mechanism with two parallel 6 mm steel rods..

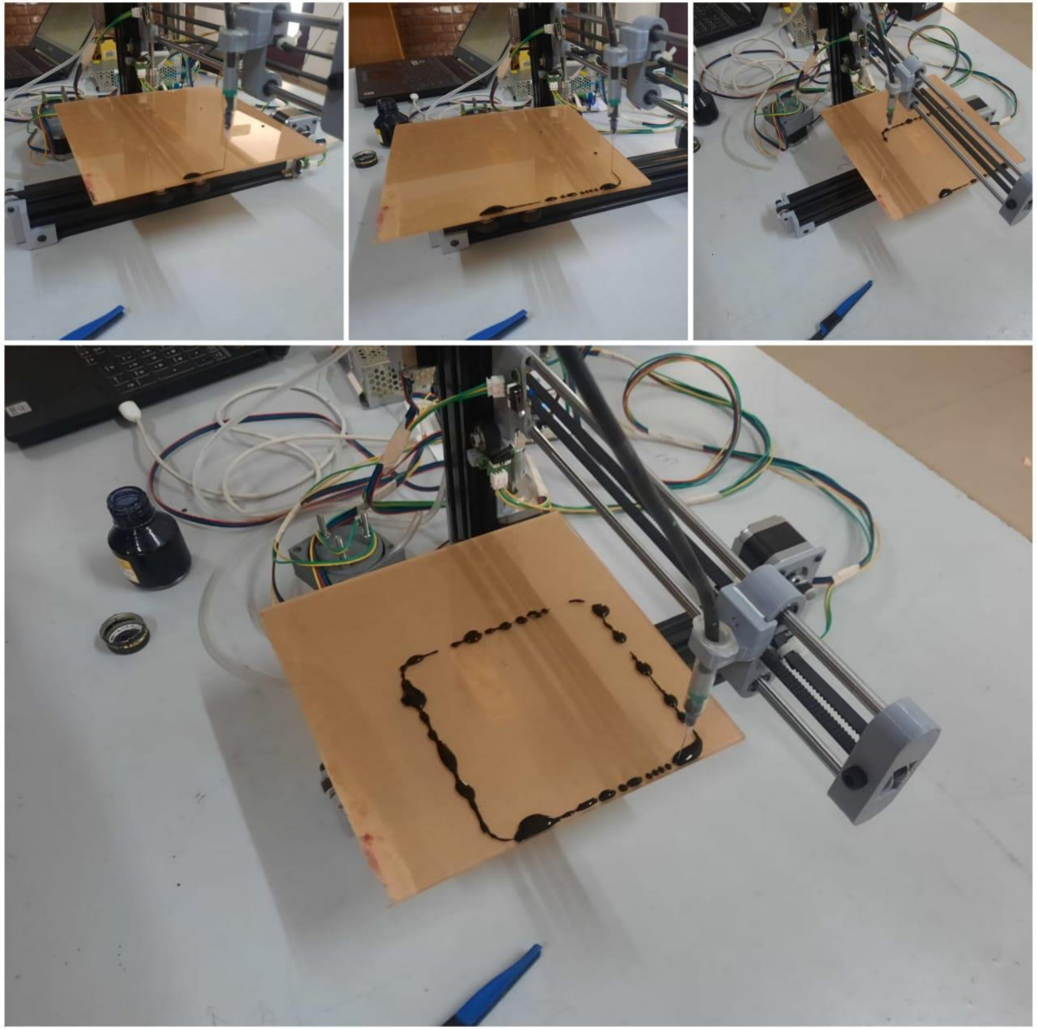


## Cartesian Kinematics

Utilizes a rectangular Cartesian coordinate system to move the print head along X, Y, and Z axes.

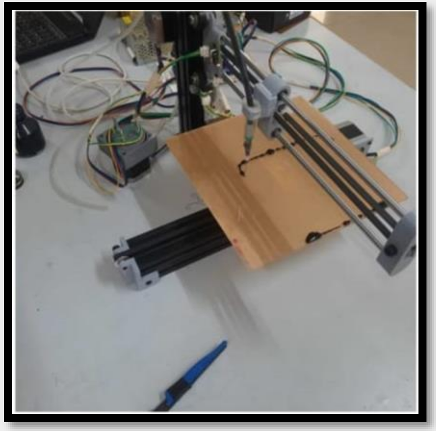
## Precise Movement

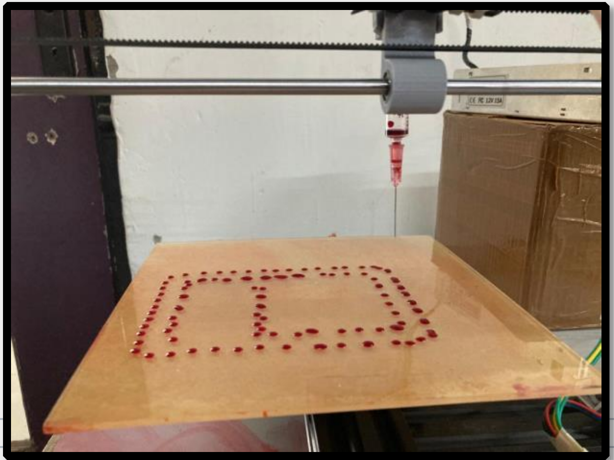
Stepper motors and linear rails ensure accurate and repeatable movement of the print head for precise 3D prints.



# Results and Discussions

The custom ink printer features a rigid and stable structure, enabling flawless motion control and precise ink deposition onto the subtract. The controlled ink deposition head, utilizing a 2cc 25-gauge syringe, stepper motors, and a microcontroller, allows for precise control over ink flow rate and deposition position, ensuring high precision and accuracy in the printing process



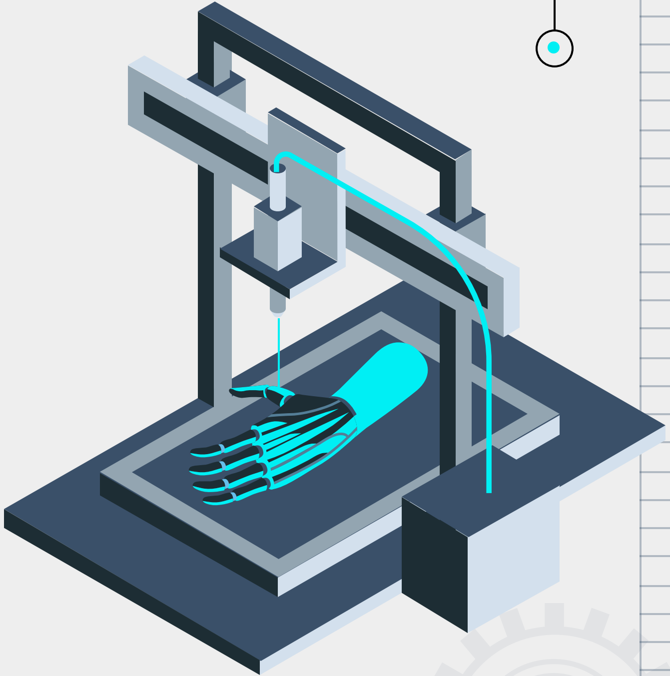


The printer's three-axis control structure, equipped with stepper motors and linear guides, enables precise control of the printing head along the X, Y, and Z axes, resulting in accurate and consistent printing as per the digital model. The linear guides facilitate smooth and stable movement of the printing head, contributing to the printer's high precision and accuracy. Additionally, optimization of process parameters such as ink viscosity, printing speed, and ink temperature ensures controlled ink flow, leading to high-quality printed circuits with minimal defects.

# Conclusion

1. The ink printer shows promise in delivering high-quality prints that can be tailored to specific needs. It allows for customization through adjustable ink settings, enabling desired outcomes.

2. Constructing a custom ink printer is a multifaceted endeavor that demands expertise in electronics, mechanics, and software programming. In essence, the custom ink printer offers notable benefits, such as the capacity to generate customized high-quality prints.



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